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CLAIMS

[Claim(s)]
[Claim 1] Surround said deflection section which made thickness uniform, and this deflection section, and it consists of a deflection section housing thicker than this deflection section. It is the semi-conductor acceleration sensor characterized by having prepared the narrow section for uniting this deflection section with said housing in said deflection section, and this narrow section preparing the stress detection section in the predetermined position of said narrow section which inclined from said boundary section while forming it broadly in the boundary section with said housing.
[Claim 2] The semi-conductor acceleration sensor according to claim 1 by which said narrow section is characterized by carrying out two or more formation by the equiangular distance towards said housing at the radial.
[Claim 3] The semi-conductor acceleration sensor according to claim 1 or 2 characterized by performing processing of the thickness direction by etching at least.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Especially this invention detects the stress produced according to physical external force, such as a pressure, acceleration, and mechanical oscillation, about a semi-conductor acceleration sensor, and relates to the semi-conductor acceleration sensor outputted as a signal which changes this stress into an electrical signal and represents said external force.
[0002]
[Description of the Prior Art] In recent years, the semi-conductor acceleration sensor which can make acceleration information an electrical signal and can carry out a direct output as a sensor which detects acceleration and deceleration (henceforth [these are summarized and] "acceleration") is used widely. This semi-conductor acceleration sensor is adopted as small and a collision detection sensor [in / it is lightweight, for example, / the air bag system for automobiles].
[0003] An example of a semi-conductor acceleration sensor is shown in drawing 3 and drawing 4 : An acceleration sensor 1 is processed and manufactured by the configuration of a request of the substrate of GaAs by etching in drawing 3 . This acceleration sensor 1 consists of the deflection section 12 jutted out of the frame 11 and this frame 11 over the method of inside in the cantilever format. The weight part (henceforth a "mass") 14 which made thickness larger than the root Motobe 13 is formed at the tip of the deflection section 12, and it enables it to take the large amount of deflections by acceleration, as shown in the sectional view of drawing 3 (b). Stress detector element 13a, such as FET formed in piles in the layer of a semi-conductor, is prepared, said root Motobe's 13 front face, i.e., stress generating part.
[0004] He is trying to prepare a stress detector element in root Motobe's 13 front face on which a mass 14 is formed as mentioned above, and generating stress serves as max for enlarging sensibility, or an output signal/noise ratio (S/N ratio), as large generating stress can be taken to the same acceleration.
[0005] If the acceleration of the direction of arrow-head A is given to this acceleration sensor 1, a deflection will occur in said root Motobe 13. According to a deflection, the drain (source) current IDS of said FET13a changes with these deflections. The variation of Current IDS is changed into an electrical-potential-difference value, and is taken out as an electrical signal representing the magnitude of acceleration.
[0006] Drawing 4 is the acceleration sensor of the structure which supported the deflection section 12 in the both-ends

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supporting beam format in the frame 11. In this acceleration sensor 1, when acceleration is given in the direction of arrowhead A, there is the description that many acceleration measurement sizes can be taken by the deflection of the deflection section 12 since stress also with large root Motobe 17 and 18 of the mass 14 besides [a frame 11] two root Motobe 15 and 16 occurs. That is, FET13a as a stress detector element can be prepared root Motobe or near [its] the four places. [said] However, the difference between tensile stress and compressive stress is in the stress detected by root Motobe 15, 16, and 17 and 18.

[0007] As mentioned above, in the conventional acceleration sensor, although it enables it to take a large S/N ratio, when it is bent by one side considering the magnitude of acceleration and generating stress is too larger than the breaking stress of the section 12 at it, the deflection section 12 has a possibility of breaking from the root Motobe 13. Then, whenever [insurance] is foreseen, it bends and the configuration, the dimension, etc. of section 12 grade are designed so that generating stress may not exceed said breaking stress.

[0008] However, with the conventional structure, since a cross-section configuration changes by said root Motobe 13, 15-18 and thickness is changing, stress concentrates on this thickness change part, and there is a possibility of exceeding breaking stress easily. Concentration of stress has high configuration dependencies, such as an aperture include angle of a corner, and curvature.

[0009] In order to cancel the fault by such stress concentration, the acceleration sensor which forms the R section, i.e., the radii section, in the change part of said thickness, and avoided concentration of stress into it is proposed (JP,64-18063,A, JP,1-302167,A). He drops the angle of a corner on isotropic etching, and is trying to form the smooth radii section in the acceleration sensor indicated by these official reports.

[0010]

[Problem(s) to be Solved by the Invention] However, it was not easy for dispersion in process tolerance to be large and to not necessarily acquire a desired radii configuration correctly in etching processing. For this reason, extent of a factor of safety or the magnitude of the stress concentration by precision dispersion of etching processing besides dispersion of an ingredient on the strength must also be considered. Consequently, it carried out making a mass 14 small etc., and must stop having had to aim at reduction of stress, and there was a trouble that a S/N ratio fell.

[0011] The above-mentioned trouble is canceled, precision dispersion of etching processing makes small effect which it has on stress concentration, and the purpose of this invention has a S/N ratio in offering the semi-conductor acceleration sensor which can take large structure.

[0012]

[Means for Solving the Problem] This invention for solving the above-mentioned technical problem and attaining the purpose Thickness consists of the uniform deflection section and a deflection section housing thicker than this deflection section, and prepare the narrow section for uniting this deflection section with said housing in said deflection section, and while forming this narrow section broadly in the boundary section with said housing The description is in the point of having prepared the stress detection section in the predetermined position of said narrow section which inclined from said boundary section.

[0013]

[Function] According to the above-mentioned description, since the deflection section has uniform thickness, there is no stress concentration part in itself. Moreover, the stress detection section is prepared in the narrow section of the deflection section, and the thickness change section which is, the boundary, i.e., only stress raisers, of the deflection section and a housing, is made broad. Therefore, the stress maximum in the narrow section in which the stress detection section was prepared occurs. Consequently, in the form status change-ized section of the boundary of the deflection section and a housing, if the nominal maximum stress on a design is set up in said stress detection section, even if it takes concentration of stress into consideration, there are few possibilities that the stress generated there may exceed nominal maximum stress.

[0014]

[Example] Hereafter, this invention is explained to a detail with reference to a drawing. The top view of the semi-conductor acceleration sensor which drawing 1 (a) requires for the example of this invention, and drawing 1 (b) are the sectional views in the B-B location of drawing 1 (a). Moreover, drawing 1 (c) and (d) are distribution maps of stress generated in the deflection section of a semi-conductor acceleration sensor. In drawing 1 , the deflection section 12 jutted out over the inside in the cantilever format is formed in the frame 11 of the semi-conductor acceleration sensor 1 into which the substrate made from GaAs was processed by etching. In addition, in order to clarify the range of the deflection section 12, it is a sign x0 to drawing 1 . The range was shown. This deflection section 12 consists of the narrow section 122 which supports a mass 121 and this mass 121 in a frame 11. the inside of drawing, and the range of the narrow section 122 -- sign x1 It was shown. In order for there to be no thickness change part between a mass 121 and the narrow section 122 and to make a S/N ratio high so that it may see in the sectional view shown in drawing 1 (b), width of face of the narrow section 122 is made small to the mass 121, and also the thickness of the deflection section 12 whole is uniform. On the other hand, the narrow section 122 makes width of face have expanded gradually toward a frame 11 side, and the width of face serves as max by root Motobe 123. Thus, since said mass 121 and narrow section 122 have lost change of thickness, they can avoid concentration of the stress resulting from dispersion in etching.

[0015] On the other hand, it is not avoided that cross-section form status change-ization by thickness change occurs on the boundary 123 of the deflection section 12 and a frame 11, i.e., root Motobe. In this example, since width of face of the cross-section form status change-ized section which stress concentrates by having formed so that width of face of the narrow section 122 might be gradually enlarged toward frame 11 direction is enlarged, the drag force to stress concentration increases.

[0016] On the other hand, the stress detector element 19 deflects only distance OS from root Motobe 123 of a deflection part, and was arranged into the minimum width-of-face part of the narrow section 122. This arrangement location is the

greatest tensile stress sigmamax, as both width of face and thickness are the minimum parts among the deflection parts 12, and it is shown in drawing 1 (c), since it is close also to Puerariae Radix Motobe 123. It generates. on the other hand, stress sigmamax which generates relatively stress sigmax generated in this part in the arrangement section of the stress detector element 19 even if it takes stress concentration into consideration by part for said stress raisers 123, i.e., root Motobe, since the width of face of the narrow section 122 is wide It is small. Therefore, said stress sigmamax Since only stress sigmax [smaller than the maximum nominal stress of this semi-conductor acceleration sensor 1] are generated in the maximum nominal stress on a design, then root Motobe 123, it does not destroy with the acceleration which generates the stress below the maximum nominal stress.

[0017] In addition, as an arrangement location of said stress detector element 19, although the location of illustration is the optimal, what is necessary is just the location which is not limited to this but has offset of a constant rate among the narrow sections 122 from the boundary section 123 of the deflection part 12 and a frame 11, i.e., root Motobe.

[0018] Next, the stress distribution of the conventional semi-conductor acceleration sensor is shown in drawing 2 R> 2 for the comparison with the semi-conductor acceleration sensor of this example. In this drawing, drawing 3 and a same sign show the same or an equivalent part. Like drawing 2 , concentration of stress is large especially at rear-face root Motobe 13, the deflection section 12, and root Motobe 20 of a mass 14, and it is maximum nominal stress sigmamax about the stress by the side of root Motobe's 20 front face. When it generates, generating stress sigmaz by the side of root Motobe's 20 rear face and the rear face of root Motobe 13 of a mass 14 is said maximum nominal stress sigmamax. It comes to exceed. This maximum nominal stress sigmamax As a result of the stress concentration in root Motobe's 13 rear face, and the rear face of root Motobe 20 of a mass 14, when it is breaking stress, even if the stress of the surface section is below the maximum nominal stress, it is bent by that small stress and the section 12 may be destroyed. It is necessary to set up the maximum nominal stress so that the stress concentration of the rear face of the deflection section 12 may become below breaking stress, and from such stress distribution, it will be bent by the conventional acceleration sensor as the result, and it will be said in the stress detection section of the front face of the section 12 at it that small stress, i.e., small acceleration, can be measured.

[0019] In addition, in this example, although the cantilever narrow section was explained to the example, this invention is applicable about the format which formed two or more narrow sections 122 in the radial by the equiangular distance not only towards this example but towards the frame 11, i.e., a both-ends supporting beam format, and the 4 direction supporting beam format which supported the deflection section from four directions similarly. In short, the thickness of the deflection section is uniform, the narrow section is prepared in this deflection section at housing approach, and while increasing the width of face of this narrow section by said housing side and forming it, the stress detection section should just be prepared in the predetermined position of said narrow section offset from the boundary section of said deflection section and housing. Also in this case, it cannot be overemphasized that the stress which multiplied by the safety factor in consideration of ingredient dispersion etc., the amount of offset, etc. are set up.

[0020]

[Effect of the Invention] In this invention, the boundary section, i.e., the form status change-ized section, and the stress detection section of the deflection section and a housing were shifted, and width of face of said form status change-ized section was made larger than the width of face of the stress detection section so that clearly from the above explanation. Therefore, since the stress concentration in the form status change-ized section can be eased, even if dispersion is in the process tolerance by etching, it can prevent that can restrict the stress of the form status change-ized section to below the maximum stress detected in the stress detection section, it is bent by stress below the maximum nominal stress as the result, and the section breaks.

[0021] Moreover, since the stress concentration in the form status change-ized section can be eased, the maximum nominal stress can be enlarged, consequently improvement in a S/N ratio can be aimed at.

[0022] Furthermore, since the deflection section is a flat configuration with uniform thickness, the bending moment by the acceleration applied to a longitudinal direction to the deflection section compared with the case where the mass is formed, with the thickness of the deflection section does not act. Therefore, it can consider as a directive high acceleration sensor.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the top view, sectional view, and stress distribution Fig. of the acceleration sensor which shows one example of this invention.

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[Drawing 2] It is the top view, the conventional sectional view, and conventional stress distribution Fig. of an acceleration sensor.
[Drawing 3] It is the conventional top view and conventional sectional view of an acceleration sensor of a cantilever narrow section format.
[Drawing 4] It is the conventional top view and conventional sectional view of an acceleration sensor of a both-ends support narrow section format.
[Description of Notations]
1 — Acceleration sensor 11 — Housing 12 — Deflection section 19 [122 — Narrow section 123 — Root Motobe] — A detector element, 121 — Mass

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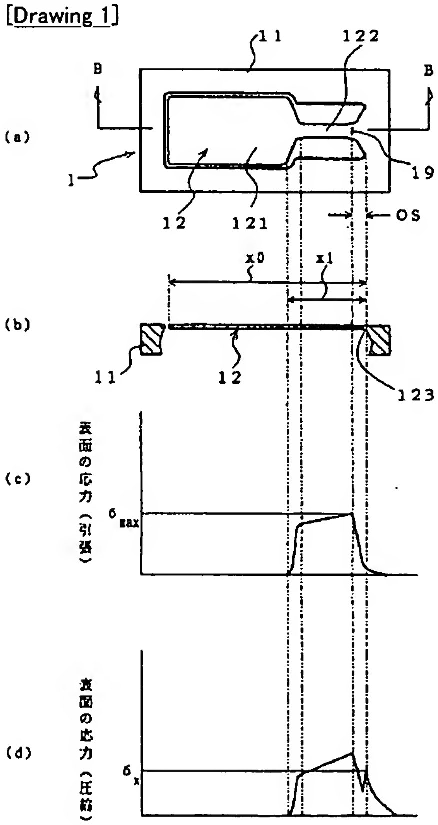
DRAWINGS

[Drawing 1]



[Drawing 2]

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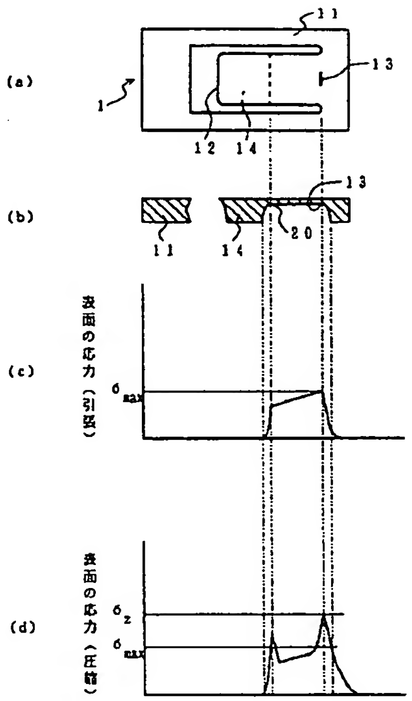
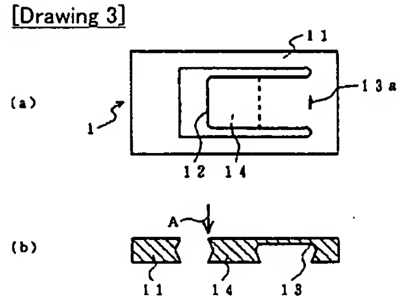
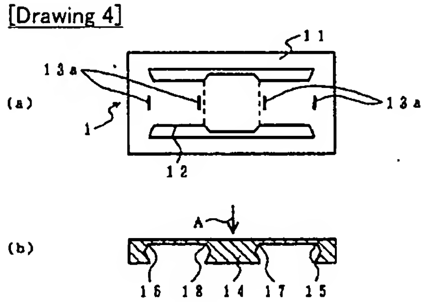


[Drawing 3]



[Drawing 4]



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